

DIET OF PILOTFISH, *NAUCRATES DUCTOR* (CARANGIDAE), ASSOCIATED WITH FADS IN SICILIAN WATERS (CENTRAL MEDITERRANEAN).

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ABSTRACT. - Pilotfish, *Naucrates ductor*, are taken as a by-catch of the dolphinfish FAD (fish aggregating devices) fishery in Sicilian waters. In order to assess the diet of this poorly known species, the stomach contents of 80 specimens (between 21 and 29 cm SL) were analysed. Fishes were sampled between October 1994 and January 1995 on board of purse seiners fishing off NE and SE Sicily (central Mediterranean). Pelagic crustaceans (especially hyperiid amphipods) were the most abundant dietary item, followed by pelagic gastropods (Atlantidae) and fish larvae. Pilotfish seem to have a planktivorous diet up to a length of about 30 cm (age 6 months); larger specimens become unavailable to sampling, probably because they abandon floating objects and take an erratic attitude in open waters. The link of pilotfish with floating objects is still not clear, though several hypotheses (protection, visual stimulus and help in predation) are suggested.

RÉSUMÉ. - Régime alimentaire du poisson pilote, *Naucrates ductor* (Carangidae), associé aux DCPs dans les eaux siciliennes (Méditerranée centrale).

Le poisson pilote, *Naucrates ductor*, est une espèce accessoire de la pêche à la coryphène avec les dispositifs de concentration de poissons (DCP) dans les eaux siciliennes. Dans le but d'étudier le régime alimentaire de cette espèce peu connue, les contenus stomacaux de 80 exemplaires (entre 21 et 29 cm LS) ont été analysés. Les poissons ont été pêchés entre octobre 1994 et janvier 1995 avec des filets tournants au large du Nord-Est et Sud-Est de la Sicile (Méditerranée centrale). La proie la plus abondante est représentée par des crustacés pélagiques (en particulier des amphipodes Hyperiidea) suivis de gastéropo-

des pélagiques (Atlantidae) et de larves de poissons. Le poisson pilote semble avoir un régime planctonivore jusqu'à une taille d'environ 30 cm (correspondant à un âge de 6 mois). Les exemplaires plus gros ne sont pas pêchés, probablement parce qu'ils abandonnent les objets flottants et adoptent des habitudes erratiques dans un environnement pélagique. Les relations du poisson pilote avec les objets flottants ne sont pas encore claires, bien que différentes hypothèses (protection, stimulus visuel et prédation) puissent être suggérées.

Key words. - Carangidae - *Naucrates ductor* - MED - Sicily - Diet - Feeding habits - FADs.

Pilotfish, *Naucrates ductor* (Linnaeus, 1758), is an epipelagic species distributed in tropical and subtropical seas (Smith-Vaniz, 1986). Adults are commonly associated with large-sized pelagic organisms, such as sharks and manta rays, whereas juveniles are often found below drifting seaweeds and floating objects. In the Mediterranean Sea, pilotfish are a by-catch of the seasonal (August through December) dolphinfish FAD (Fish Aggregating Device) fisheries (Bono *et al.*, 1998; Reñones *et al.*, 1998). *Naucrates ductor* is also considered the most characteristic species of the fish assemblage associated to floating objects in the western Mediterranean (Massutí and Reñones, 1994), due to its year-round presence near flotsam. This is confirmed by the year-round observations made around an offshore buoy in the Ligurian Sea (Relini *et al.*, 1994).

The objective of the present work is to provide some data on the diet of this poorly known species caught around FADs in Sicilian waters. Only few information has been published on this topic from the Mediterranean Sea (Relini *et al.*, 1994; Reñones *et al.*, 1998), and also the relevant literature from other areas is scarce. This paper can help to gain a better knowledge of the possible links between FADs and associated fishes, and of the relationships existing between these fish species.

Materials and methods

The study area is included within the FAD fishery areas located off the NE and SE Sicilian coasts (Fig. 1), where FADs were deployed along radial rows starting at about 6 miles

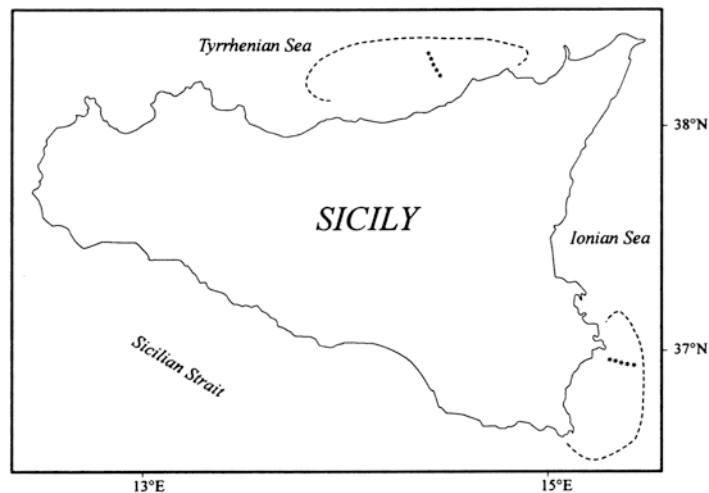


Fig. 1. - Map of the study area. The dashed line delimits the FAD fishery areas. Pilotfish used in this study were collected in the sites indicated by asterisks.

Table I. - Stomach content of pilotfish collected in Sicilian waters. O%: percent occurrence; N%: percent abundance; W%: percent wet weight; IRI: index of relative importance.

Prey item	O%	N%	W%	IRI
Mollusca	86.30	6.28	28.34	2987.42
Atlantidae	84.93	6.27	28.21	2928.10
Gastropoda (unidentified)	1.37	0.01	0.13	0.19
Annelida	47.95	4.68	2.30	334.63
Alciopidae	47.95	4.68	2.30	334.63
Crustacea	97.26	88.05	65.60	14944.39
Copepoda	5.48	0.06	0.02	0.44
Cirripedia (Lepadidae)	1.37	0.02	0.02	0.05
Stomatopoda (larvae)	32.88	0.61	2.43	99.98
Mysidacea	8.22	0.45	0.04	4.06
Isopoda	1.37	0.01	< 0.01	0.01
Amphipoda (Hyperidea)	93.15	85.46	61.46	13685.83
Euphausiacea	5.48	0.04	0.05	0.52
<i>Sergestes</i> sp.	20.55	0.32	0.19	10.36
Natantia (unidentified)	13.70	0.13	0.16	4.06
Decapoda (larvae)	47.95	0.90	1.20	100.44
Crustacea (unidentified)	8.22	0.05	0.03	0.64
Tunicata	4.11	0.28	0.13	1.71
Appendicularia	4.11	0.28	0.13	1.71
Osteichthyes	50.68	0.62	3.61	214.26
Larvae	50.68	0.62	3.61	214.26
Eggs of unknown taxa	1.37	0.10	0.01	0.15
No. total stomachs = 80				
No. empty stomachs = 7				
Mean prey number per stomach = 155.6 ± 180.85 s.d.				
Mean prey weight per stomach = 3.6 ± 8.63 s.d.				

offshore. Eighty pilotfish ranging between 21 and 29 cm standard length (mean = 24.6 cm $\pm$ 1.91 s.d.) were collected from October 1994 to January 1995 in the NE (no = 60) and SE (no = 20) areas (Fig. 1). The estimated age of these specimens ranged from 4 to 6 months, according to the otolith readings made by Potoschi *et al.* (1998). Samples were taken on board of commercial purse seiners of the dolphinfish FAD fishery (Potoschi, 1998). FADs were made with palm branches deployed 3 to 40 miles offshore and moored at depths of about 200 to 1000 m. The fishes were eviscerated immediately after the catch, and the stomachs were preserved in a 10% seawater-formalin solution for subsequent analysis of contents. In the laboratory, all prey items were identified to the lowest possible taxonomic level, counted and weighed (wet weight at 0.001 g). The count of fragmented preys was based on the number of eyes, mouth parts, tails or other anatomical parts referable to single specimens. The importance of each prey item in the diet of pilotfish was assessed by means of the following indexes (Hureau, 1970):

- feeding index, where fs = no. stomachs with food, ts = no. total stomachs:

$$FI = fs / ts$$

- percent occurrence, where s_p = no. of stomachs containing prey p :

$$O\% = (S_p / fs) \times 100$$

- percent numerical abundance, where n_p = abundance of prey p , tn = total abundance of preys:

$$N\% = (n_p / tn) \times 100$$

- percent weight, where w_p = weight of prey p , tw = total weight of preys:

$$W\% = (W_p / tw) \times 100$$

- index of relative importance:

$$IRI = (N\% + W\%) \times O\%$$

Results

Seven stomachs out of 80 were empty ($FI = 0.90$). The result of the stomach contents analysis in pilotfish is shown in table I. Seventeen items grouped in five main taxa were found. Crustaceans were the dominant group ($O\% = 97.26$, $N\% = 88.05$, $W\% = 65.60$, $IRI = 14944.39$), followed by molluscs, fishes, annellids and tunicates. Hyperiid amphipods were the dominant prey item ($O\% = 93.15$, $N\% = 85.46$, $W\% = 61.46$, $IRI = 13685.83$). The second item in

terms of importance was atlantid gastropods ($O\% = 84.93$, $N\% = 6.27$, $W\% = 28.21$, $IRI = 2928.10$). Fish larvae occurred in 50.68% of non-empty stomachs, although their contribution by number and weight was low ($N\% = 0.62$, $W\% = 3.61$). Alciopid annellids occurred in 47.95% of non-empty stomachs, and contributed to the diet of pilotfish with 4.68% by number and 2.30% by weight. Decapods as a whole were the second most important group within crustaceans. Decapod larvae occurred in 47.95% of non-empty stomachs, juvenile *Sergestes* sp. in 20.55% and unidentified Natantia in 13.70%.

No comparison of diets was attempted between specimens collected in the two areas or in different periods, due to the small sample size.

Discussion

Pilotfish caught around FADs off the NE and SE Sicilian coasts in autumn and early winter have essentially a planktonic diet. The bulk of the stomach contents analysed was composed of pelagic crustaceans (especially hyperiid amphipods and larvae of stomatopods and decapods). Other frequent prey items were atlantid gastropods, fish larvae and alciopid annellids. These data are similar to those reported by Reñones *et al.* (1998) for the Balearic Islands and by Relini *et al.* (1994) for the Ligurian Sea. The main differences consist in a greater occurrence and abundance of decapod larvae and copepods in the Balearic specimens and in a much lesser abundance of atlantid gastropods in the Ligurian specimens. Vaske-Junior (1995) reported a larger importance of fish prey in the diet composition of a small sample of pilotfish ($n = 39$) caught off the southern Brazil coast. According to Mediterranean data, pilotfish feed on plankton for at least the first six months of life, when they grow rapidly and approach the sexual maturity (Potoschi *et al.*, 1998; Reñones *et al.*, 1998). We do not know if an ontogenetic shift occurs at an older age (although this is probable), since the Mediterranean fisheries include only specimens not larger than 29-30 cm. This is smaller than the reported maximum size for the area (63 cm fork length according to Smith-Vaniz, 1986). Probably around the age of six months pilotfish abandon the association with floating objects and adopt a more erratic behaviour, that make them unavailable to common sampling methods and to fishermen. A similar behaviour is displayed by the greater amberjack *Seriola dumerili*, which is closely associated with flotsam up to

a size of about 10 cm, after which it leaves the upper layers of water and changes feeding habits (Pipitone and Andaloro, 1995).

Several hypotheses have been proposed to explain the link of some fishes with flotsam. Massutí and Reñones (1994) have suggested for pilotfish a likely function of protection and of visual stimulus in the uniformity of the pelagic environment. The floating object can probably also play a role in predation, which seems to be based on the visual identification of prey (Gorelova, 1979). Such role has been suggested also for juvenile amberjack associated to FADs in NW Sicily (Badalamenti *et al.*, 1998). FADs do not seem to have any direct role in the feeding of associated fishes (Ibrahim *et al.*, 1996), and this is likely true for pilotfish as well. Previous studies (Relini *et al.*, 1994; Reñones *et al.*, 1998) have highlighted the absence of any fouling organisms living on the FADs in the stomach contents of pilotfish. Our study confirms this, since only two lepadid cirripeds were found in the stomach of a 29 cm specimen collected in the Tyrrhenian Sea.

Acknowledgements. - The authors wish to thank Dr Luca Castriota and Dr Gaspare Di Stefano for the help provided in the identification of prey species, and the anonymous referees for their comments. This work is part of a study funded by the Italian Ministry of Merchant Navy.

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Reçu le 23.08.1999.

Accepté pour publication 24.02.2000.